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A REVIEW ON WIRELESS SENSOR NETWORK USED IN OPTICAL COMMUNICATION

Gurpreet Singh [1] | Er. Parveen Kaur [2]

[1] Research Scholar, Department Of Electronics and Communication Engg., Guru Gobind Singh College Of Engg. & Technology, Guru Kashi University, Talwandi Sabo, Bathinda, Punjab, India.

[2] Assistant Professor, Department Of Electronics and Communication Engg., Guru Gobind Singh College Of Engg. & Technology, Guru Kashi University, Talwandi Sabo, Bathinda, Punjab, India.

ABSTRACT

Wireless sensor networks play a major role in monitoring and control in industrial sectors. The evolution towards the information-oriented world, the demand for data capacity and transmission quality has also increased. There are many advantages of using WSNs including less energy consumption, reliability, and so on. In Optical communication, an MDM is the biggest challenge to reducing a crosstalk using a wireless network. This will include basic concept of Optical communication, components, and its advantages. Optical communication is widely useful in telecommunications systems networking and data processing. This paper will review different Wireless Sensing Networks (WSNs) used in Optical communication. The aim of this paper is to study the different techniques and multiple applications in WSN.

KEY WORDS: Wireless Sensing Networks (WSNs), Optical communication, MDM, Signal-to-noise ratios and bit error rates.

I. INTRODUCTION

1.1. Optical communication

Optical communication is the type of communication which uses light to transfer the signal from transmitter to receiver end, rather than electrical current. The main components of Optical communication are transmitter or receiver, modulator or demodulator, a light signal and a transmission channel. It consists of the transmitter to transmit an optical signal, a channel to carry the signal and a receiver which receives the optical signal. Optical communication depends on optical fibres to transfer signals from the source to destination. Optical communications systems try to address the constraints of radio frequency communications.

1.1.1. Components of Optical communication system

Optical communication systems comprise of the components:

- **Transmitter:** The transmitter or source end converts and electrical signal to light signal and transmits it to the receiver end. The most common transmitters which are used are semiconductor devices, for example, laser diodes and light-emitting diodes (LEDs) and laser diodes.
- **Receivers:** Receiver or destination typically comprise of a photo-detector. The photo-detector is a semiconductor-based photodiode which changes over light signal into electrical signal utilizing the photoelectric impact.
- **Optical Fiber:** Optical fiber comprises a cladding, core, and a buffer by which the cladding directs the light signal to the core by utilizing total internal reflection.

1.1.2. Advantages of optical communication:

Optical communications have several advantages; some of them are listed below:

- The primary advantages of optical communication incorporate high data transfer capacity or bandwidth, very low rates of losses, no electromagnetic interference, and broad transmission range.
- Optical communications range has not been controlled, so the user does not have to stress over available locations.
- Optical communications systems are much lighter, smaller and consume less power as compared to radio frequency systems.

The limitations of optic communication system incorporate the high cost of transmitter/receiver, cable and other equipment, and the need of expertise and skill during installation and interconnection of cables.

1.2. Wireless Sensor Networks (WSNs)

Nowadays, an effective design of a Wireless Sensor Network (WSN) has become a main area of research. A Sensor is an instrument or device which detects some kind of signals from physical as well as from environmental conditions, for example, heat, pressure, light, and so on, and responds accordingly. The output of the sensor is, for the most part, an electrical signal which is transmitted to a controller to be processed further.

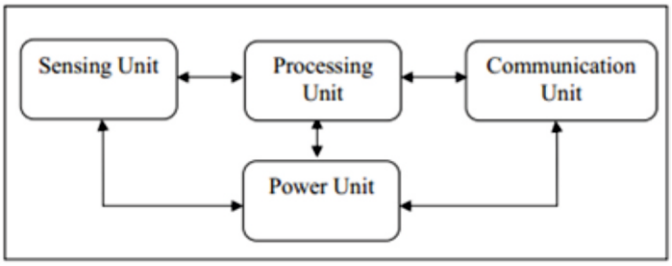

Figure 1: Block diagram of sensor node

A Wireless Sensor Network is a distributed system, and it involves a huge amount of distributed, self-coordinated, low powered, small devices called sensor nodes . WSN envelops countless scattered, battery-operated, installed devices which are connected to collect, process, and transfer information to the users, and it has limited computing and processing abilities .Remote sensor nodes are consisting of sensing unit, a processing unit, power unit, and communication unit .Each node is proficient in performing information gathering, sensing, processing and interacting with different nodes .The sensing unit detects the surrounding, the processing unit calculates the bound stages of the detected information, and the communication unit performs transfer of processed data to the neighboring sensor nodes .[٢]

1.2.1. Application of WSNs

- WSNs are utilized as a part of environmental tracking, for example, animal tracking, forest detection, flood detection, weather prediction and forecasting, and furthermore, in business applications like seismic exercises forecast and observing.
- The most as often as possible utilized WSN applications in the area of Transport systems, for example, observing traffic, element routing management and checking of parking areas, and so forth. utilize these networks.
- Health applications, for example, Tracking and checking of patients and specialists utilize these networks.
- Military applications, for example, Enemy tracking, monitoring environment as surveillance applications, security detections, utilize these systems. The sensor nodes are released to the field of intrigue and are remotely monitored and controlled by a user.

1.3. Mode-Division Multiplexing in Optical Communication

Mode division multiplexing)MDM(is a multiplexing approach proposed as a technology to address future transfer speed issues and has been effectively exhibited in free space utilizing spatial modes along with orbital angular momentum)OAM(. In MDM based communication networks, every spatial mode, from an

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orthogonal modular source, could transfer a free data stream, in this manner expanding the overall capacity by a variable equivalent to the number of modes utilized. More degrees of freedom are needed to frame a thickly stuffed mode space to enhance the information transmission rate further .Hence, the proposed mode-division multiplexing procedure in optical communication in view of OAM modes is exceptionally encouraging for expanding the capacity of optical communication systems in a power-saving effective technique, without the powerful utilization of modular de- multiplexing misusing real-time electronic processing .

II. FINDINGS

Many types of research have been done over WSNs, and several WSNs approaches have been proposed. The table 1 shows the results of our finding if literature review based on different WSNs techniques in the context of Optical communication. The table below

Table 1 :Findings of different existing WSNs methods

Author and Year	Method	Input	Output
I .Khan, et al.[1]	Review of WSN Virtualization	Studied different existing WSN Virtualization projects	VITRO and FRESnel are most popular projects providing WSN virtualization
K .Munusamy, et al.[2] (2016)	Least-Power Adaptive Hierarchy Cluster (LPAHC) using Frequency Division Multiplexing (FDM) Channelization technique	Density of sensors, energy consumption, average energy cost, and average delay time consumption	Reduced the energy consumption and average energy cost.
H .Zhang, et al[3]. (2015)	OFDMA two-way relay wireless sensor network	subcarrier pairing, subcarrier assignment, and power allocations	Maximize secrecy rate, and transmit power
Y .Ren, et al.[4] (2016)	Spatial domain to concurrently transmit multiple orthogonal spatial beams	four green orbital angular momentum (OAM) beams	degrading effects of scattering/turbidity, water current, andthermal-gradient-induced turbulence
P .Y .Kong ,et al. [5] (2015)	Grouped smart meters to access a shared wireless channel in a time-division-multiplexing manner using Aloha protocol	packet delay, packet error probability, and outage probability	Packet delay less than 1.0s, packet error probability less than 0.005 and outage probability less than 0.01.
A .Amphawan, et al.[6] (2015)	Optical mode division multiplexing (MDM) scheme for Ro-FSO using optical Hermite-Gaussian modes	radio-modulated data	Signal-to-noise ratios and bit error rates
N .S .Samarasand F .S . Triantari.[7] (2016)	Investigation of Direct Diffusion Routing Algorithm (DDRA) for WSNs	Clusters	Improved energy efficiency and reduced delay
S .Aram, et al.[8] (2014)	Multi-layer perceptron (MLP)	100 realizations of stochastic inputs	Temperature and Humidity values
Huang, H., et al.[9] (2015)	Mode division multiplexing (MDM) using a multimode optical fiber's N spatial modes as data channel and OAM mode sorter as multiplexer	PDM-QPSK data streams	(de) multiplexed the two OAM modes

III. CONCLUSION

This paper reviewed the techniques used to design Wireless Sensor Networks in the context of Optical Communication. The study identified the different methods used in Optical communication proposed by various researchers. The review of the previous WSNs techniques and approaches were presented in the form of findings. After analyzing the best technique, we will propose our design for WSN using Mode-Division Multiplexing with the aim to improve the overall capacity of the Optical communication system.

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